

- II. "Combinatorial Analysis.—The Foundations of a New Theory." By Major MACMAHON, F.R.S.
- III. "Über Reihen auf der Convergenzgrenze." By E. LASKER. Communicated by Major MACMAHON, F.R.S.
- IV. "Extinct Mammalia from Madagascar. I.—*Megaladapis insignis*, sp.n." By C. I. FORSYTH MAJOR. Communicated by Dr. WOODWARD, F.R.S.
- V. "The Kinetic Theory of Planetary Atmospheres. Part I." By G. H. BRYAN, F.R.S.
- VI. "Observations on the Effect of Desiccation of Albumin upon its Coagulability." By J. B. FARMER. Communicated by Mr. H. T. BROWN, F.R.S.
- VII. "Further Note on the Influence of the Temperature of Liquid Air on Bacteria." By Dr. A. MACFADYEN and S. ROWLAND. Communicated by LORD LISTER, P.R.S.

The Society adjourned over the Easter Recess to Thursday, May 10th.

"Mathematical Contributions to the Theory of Evolution. VII.—On the Application of certain Formulæ in the Theory of Correlation to the Inheritance of Characters not capable of Quantitative Measurement." By KARL PEARSON, F.R.S., with the assistance of Miss ALICE LEE, D.Sc., University College, London. Received August 5,—Read, November 16, 1899. Withdrawn, re-written, and again presented March 29, 1900.

(Abstract.)

(1) Many characters are such that it is very difficult if not impossible to form either a discrete or a continuous numerical scale of their intensity. Such, for example, are skin, coat, or eye-colour in animals, or colour in flowers. In other cases as in the amount of shading, degree of hairiness, &c., it might be possible by counting scales or hairs to obtain a numerical estimate of the character, but the labour in the case of several hundreds or a thousand individuals becomes appalling. Now these characters are some of those which are commonest, and of which it is generally possible for the eye at once to form an appreciation. A horse-breeder will classify a horse as brown, bay, or chestnut; a mother classify her child's eyes as blue, grey, or brown without hesitation and within certain broad limits correctly. It is clear that if the theory of correlation

can be extended so as to readily apply to such cases, we shall have much widened the field within which we can make numerical investigations into the intensity of heredity, as well as much lessened the labour of collecting data and forming records.

The extension of theory required for such investigations is provided in a separate memoir. It is found that the sole conditions for applying this theory are: (1) that an order of intensity must exist even if there be no quantitative scale; (2) that the correlation must be supposed normal. If these assumptions are made, individuals may even be classified into only two groups of less and greater intensity, and the correlation still found. For example, the correlation between stature and hair-colour could be found by classifying all individuals simply into short and tall, light and dark haired, although for convenience of judgment a medium class in each case might be introduced. For the purpose of ascertaining the relative variability of the characters involved, this third or medium class at least must be introduced and a ninefold division made of the correlation table. In the introduction to the present memoir the probable errors of all the quantities involved are considered, and illustrations given of their values for selected cases.

(2) The bulk of the memoir, however, is concerned with the application of this theory to two special cases, those of inheritance of the coat-colour of horses* and of the eye-colour of men.

There are three recognised chief types of inheritance: the blended heritage, the exclusive heritage, and the particulate heritage, to which latter two may possibly be added the reversionary heritage as a modifying factor.

In the blended heritage the character of the parents and the ancestry in the direct line are in the average offspring mingled in certain proportions. This heritage seems in broad lines to be described by the law of ancestral heredity.

In exclusive heritage the offspring takes the character of one parent to the exclusion of that of the other. While in blended heritage, reversion becomes very difficult, if not impossible, to distinguish from exceptional variation, here reversion becomes an easily detected feature; and studies on reversion ought if possible to deal with exclusive heritage. Lastly, in particulate heritage, we have a mixture, not a blend,

* The twelve tables of coat-colour inheritance have been extracted for me by Mr. Leslie Bramley-Moore out of Weatherby's Studbooks. He first pointed out to me the difficulties attending my method of proportioning, which led to my withdrawing and rewriting this paper. The twenty-four tables of eye-colour inheritance I have extracted from eye-colour data most generously placed at my disposal by Mr. Francis Galton. The arithmetic on these tables is chiefly due to Miss Alice Lee, D.Sc., but Mr. L. N. G. Filon, M.A., Mr. Bramley-Moore and Miss C. D. Fawcett, B.Sc., have given us friendly aid.

of the parental characters as in the case of a blue eye streaked with brown, eyes of two different colours, a piebald horse, &c. The occasional appearance of particulate, where we are accustomed to blended heritage, appears to be sometimes attributed to reversion.

Neither coat-colour in the horse nor eye-colour in man appear to obey the law of ancestral heredity.

(3) In coat-colour we find the horses lighter than the mares, but a secular change appears to be going on, and thoroughbred colts and fillies of to-day are more alike in colour than those of two generations back. The horse is somewhat more variable than the mare. The laws of inheritance are in excellent accord with what we should expect from the theory of exclusive inheritance without reversion; they are incompatible with the law of ancestral heredity. The only important divergence occurs in grandparental correlation.

(4) In eye-colour we find man lighter than woman, but a secular change is going on, and men and women to-day are more alike in eye-colour than they were two generations back. This change in eye-colour is possibly due to a correlation between eye-colour and fertility in woman. Man is somewhat more variable than woman. The laws of inheritance are not in accord with what we might expect from the law of ancestral heredity. They are definitely divergent from it, but agree well with exclusive heritage without reversion to ancestral types. Here again the grandparental correlation appears to be anomalously large. Great diversity exists, however, between the intensity of inheritance as exhibited by different lines of descent. For the first time in this memoir, I believe, the strength of heredity for the eight grandparental and the eight avuncular relationships is investigated. The results obtained enable us, at least for eye-colour in man, to make the following statements:—

(i) Let A and B be the grades of relationship, of which A refers to the older generation, and A and B may be of either sex. Then the variability of all the A's which have female B's is invariably greater than the variability of all the A's which have male B's. In other words, women while less variable than men, come of more variable stock.

(ii) The younger generation takes as a whole more strongly after its male than its female ascendants and higher collaterals.

(iii) The younger generation is more highly correlated with an ascendant or higher collateral reached by a line passing through one sex only than by a line which changes sex.

(iv) Men are slightly more highly correlated with their ascendants and higher collaterals than women are.

(5) The memoir concludes by insisting on the need for a wide determination of the intensity and form of inheritance for a great variety of characters in many types of life. Until this has been achieved, "plasmic mechanics" are merely hypothetical explanations of pheno-

mena,* of which we have as yet no sufficient cognizance. They strive to reach the generalisation of a Newton, without the numerical foundations laid by a Tycho Brahé and a Kepler.

“On the Retinal Currents of the Frog's Eye, excited by Light and excited Electrically.” By AUGUSTUS D. WALLER, M.D., F.R.S. Received and Read March 29, 1900.

(Abstract.)

I. Introduction.

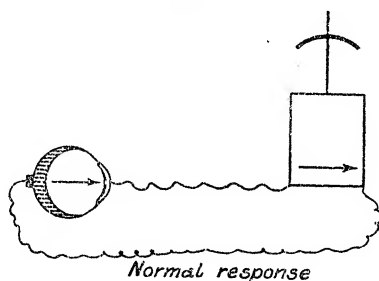
II. Plan of experiment.

III. Results.

1. A fresh normal eyeball manifests positive current, which gradually declines to zero, and becomes reversed.

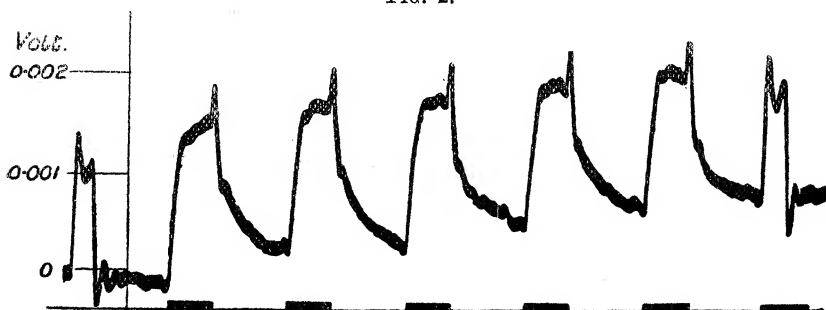
2. On exposure to light the normal current, whether positive or negative, undergoes a positive variation.

FIG. 1.



3. The magnitude of the response to light increases with the duration of illumination.

FIG. 2.



* Germ plasma and other theories are invented before we know fully the facts they are supposed to describe.